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# Visualising the Knowledge Domain of Artificial Intelligence in Marketing: A Bibliometric Analysis

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**Abstract.** As the number of research outputs in the field of AI in Marketing increased greatly in the past 20 years, a systematic review of the literature and its developmental process is essential to provide a consolidated view of this area. This study conducted a bibliometric analysis for the knowledge domain of AI in Marketing by using 617 research outputs from the Web of Science database from 1992 to 2020. Knowledge maps of AI in marketing research were visualised by employing CiteSpace software.

**Keywords:** Artificial intelligence; Marketing; Bibliometric analysis

## 1 Introduction

With the rapid development of technologies, it is predicted that Artificial intelligence (AI) will significantly change traditional marketing including marketing strategies, business models, sales processes, and customer service options [1]. AI is defined as “the ability of a machine to learn from experience, adjust to new inputs and perform human-like tasks” [2]. Due to the relevance of the application of AI in marketing for a broad group of stakeholders and the benefits and challenges connected with its implementation, adoption, and use, the field has been attracting high attention from researchers and practitioners. The previous studies investigated the application of AI in the context of sales forecasting [3], recommendation systems [4], customer classification [5], profit maximization [6], retail store scheme [7, 8], and design of the marketing campaign [9], to name a few.

A number of studies conducted a review of the literature in the field of AI [1, 10, 11]. However, limited research has been done using bibliometric analysis. It is argued that a thorough analysis and review of the key topics can offer researchers a consolidated view on this area [12, 13]. Thus, the current study aims to provide in-depth analysis with a bibliometric method of accumulated studies on AI and Marketing. To conduct the bibliometric analysis, the CiteSpace software was used to visualize and analyse trends and patterns in the scientific literature.

The rest of the paper is organised as follows. First, the research design section provides the details of the data collected and software used. Next, a statistical analysis of data is presented, followed by hotspot analysis. Finally, the paper is concluded in section 5.

## 2 Methodology

### 2.1 Source of data

This study used data from the Web of Science databases. Web of science was chosen because of its wide coverage of publications on overall academic fields and includes all bibliographic information (e.g. authors, citations, journals) for analysis. The following search terms were used TOPIC: ("Artificial intelligence" OR "artificial-intelligence" OR "machine learning" OR "neural network" OR "neural-network" OR "machine-learning") AND TOPIC: ("marketing"). Only scientific articles written in English were used for this research. As a result, a dataset of 617 articles with a period of 1992 to 2020 were collected for this analysis.

### 2.2 Data analysis tool

This study employed CiteSpace to analyse the data. CiteSpace is the analytical tool that uses Java for visualizing and analysing patterns and trends in the scientific literature [14]. This tool was applied by a number of studies from various fields [12, 13].

## 3 Research overview

### 3.1 Number of publications by year

In order to provide a picture of a development trend of the academic field, the number of publications over years in AI in the marketing domain is presented in Figure 1. As can be seen, the first article in this field was published in 1992. 56% of the articles were published in the last three years. The rapid increase from 2017 could be connected to the next-generation computing architecture, access to historical datasets, and advances in deep neural networks [15].

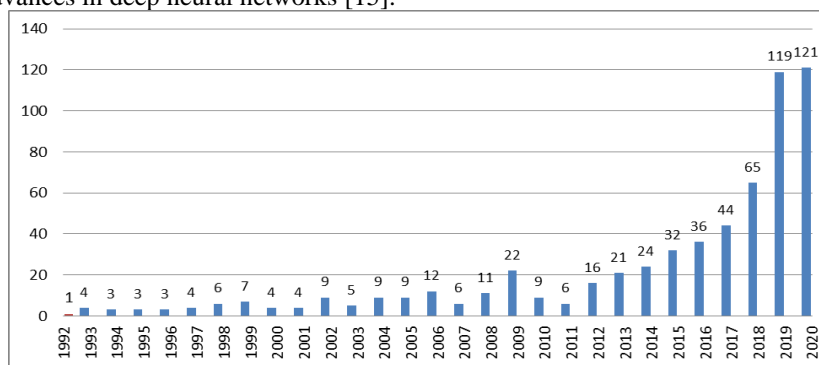


Figure 1. Number of publications of AI in Marketing articles-1992-2020

### 3.2 Source of publications

Table 1 presents the top 10 journals which published articles in the field of AI in Marketing. It was found that 617 articles were published in 353 journals. The most productive journal is found to be Expert systems with applications (45 articles), IEEE Access (14 articles), and European Journal of Operational Research (13 articles).

Table 1. Top 10 journals of AI in marketing research

Journal Name	Number of articles	%
Expert systems with applications	45	7.293
IEEE Access	14	2.269
European Journal of Operational Research	13	2.107
Industrial Marketing Management	9	1.459
European Journal of Marketing	8	1.297
Marketing Science	8	1.297
Decision Support Systems	7	1.135
International Journal of Advanced Computer Science and Applications	7	1.135
Sustainability	7	1.135
Journal of Business Research	6	0.972

### 3.3 Major publication countries and institutions analysis

The top 15 countries of publications in the field of AI in Marketing are presented in Table 2. The USA, China, Taiwan, England, and Spain rank the top five and cover 48% of total publications in the dataset. It is observed that most of the countries on the list are highly economically developed countries.

Table 2. Top 15 countries/regions with most publications in AI in marketing field

Rank	Research countries	Centrality	Number of publications
1	USA	0.45	148
2	Peoples R China	0	71
3	Taiwan	0.04	31
4	England	0.67	24
5	Spain	0.12	24
6	India	0.08	21
7	Germany	0.16	18
8	South Korea	0.12	15
9	Italy	0.39	15
10	France	0	10
11	Australia	0.09	10
12	Turkey	0.01	9

13	Poland	0.02	7
14	Netherlands	0.06	6
15	Canada	0.12	5

To examine the collaboration between countries, node types “Country” was used in CiteSpace. Figure 3 shows the collaborated network between the countries. This network has 33 nodes, 46 links, and a density of 0.0871. The results show that strong cooperation exists in groups.



Figure 3. Country collaboration network analysis

### 3.4 Author analysis

The frequency of citations on a specific author can be applied to measure the level of influence in the field. In order to do it, node type “Author” in CiteSpace was used. Figure 4 provides a knowledge map of the highly cited authors and their collaboration network; and Table 3 shows the list of highly cited authors in the field.

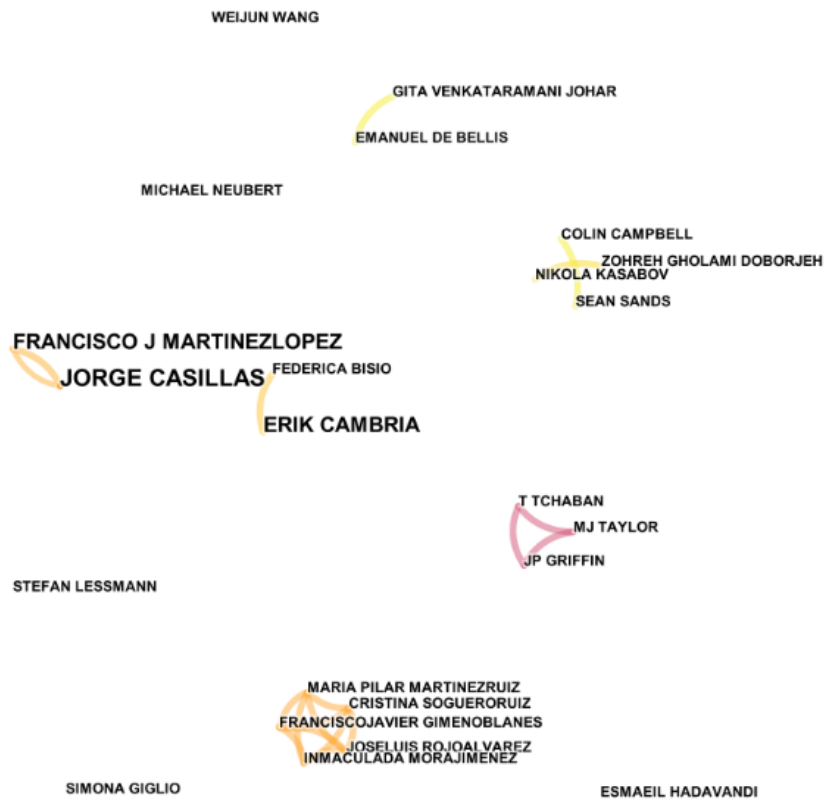


Figure 4. Author collaboration network

Table 3. Most highly cited authors

Number of publications	Author
5	Jorge Casillas
4	Erik Cambria
4	Francisco J Martinezlopez
2	Maria Pilar Martinezruiz
2	Inmaculada Morajimenez
2	Michael Neubert
2	Nikola Kasabov
2	Franciscojavier Gimenoables
2	Weijun Wang
2	Mj Taylor
2	Joseluis Rojoalvarez
2	Emanuel De Bellis
2	Esmacil Hadavandi

2	Federica Bisio
2	Simona Giglio
2	Sean Sands
2	Cristina Sogueroruiz
2	Stefan Lessmann
2	Zohreh Gholami Doborjeh
2	Colin Campbell
2	T Tchaban
2	Gita Venkataramani Johar
2	Jp Griffin

The author network has 23 nodes (authors with top published papers) and 19 links (co-authored relationships). Network density is very small, 0.0751 indicating that most of the research outputs were done independently with no long term high-intensity co-operations between authors.

According to the analysis authors with more than 4 publications are Jorge Casellas (5 articles), Erik Cambria (4 articles), and Francisco J Martinezlopez (4 publications). Considering all authors with weal or non-collaboration in their research, the two authors Jorge Casellas and Francisco J Martinezlopez formed a strong connection network in their research publications

#### 4 Analysis of research hotspots

Hotspots in the research field can be identified by the analysis of keywords [12]. A knowledge map of keywords in AI in the marketing field is presented in Figure 5. The keywords network has 141 nodes and 459 links.

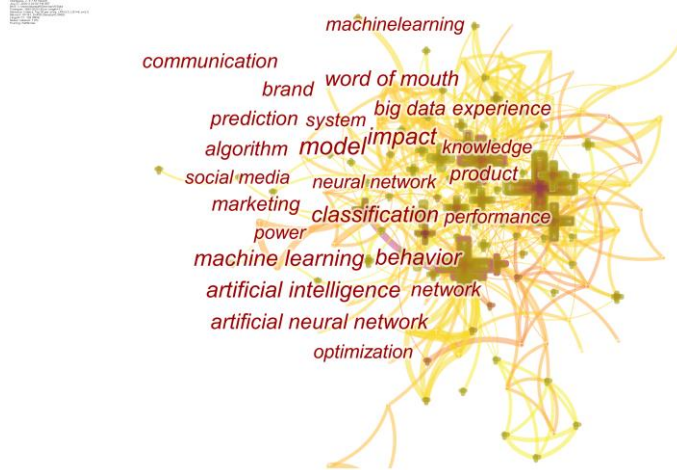


Figure 5. Co-occurrence analysis of keywords

Table 4 presents the top 10 keywords according to frequency and centrality.

Table 4. Top 10 keywords according to frequency and centrality

Keyword	Fre- quency	Keyword	Centrality
Neural network	81	Model	0.21
Machine learning	74	Behaviour	0.19
Model	58	Classification	0.15
Classification	50	Artificial intelligence	0.15
Artificial intelligence	46	Algorithm	0.14
Marketing	35	Neural network	0.13
Social media	29	Machine learning	0.13
Impact	27	Framework	0.12
Algorithm	26	Experience	0.10
Artificial neural network	26	Choice	0.09

Log-likelihood Ratio (LLR) was used to cluster the keywords. The network was divided into 8 co-citation cluster. Four major clusters will be discussed in more details below.

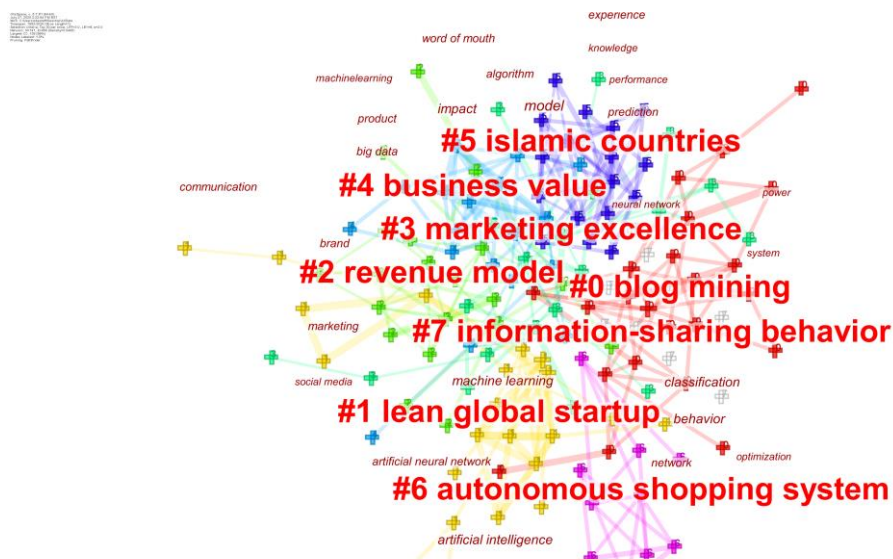


Figure 6. Cluster analysis of keywords

The largest cluster (#0) which is label “Blog mining” has 23 members. Studies in this cluster investigate how online data collected from the internet (blogs, website, social media, e-commerce sites) can facilitate companies' decision-making process. For example, [16] focused on the use of blogs for gaining insights for companies about



customer segmentation and classification. The study proposed a blog mining model that extracts knowledge from blogs. The experimental results demonstrated successful segmentation of customers and building classifier to predict characteristics of unknown customers. Another study by [17] showed how data such as movie viewing, basket addition, and purchase in e-commerce can be used for the development of deep learning-based prediction model of the next purchase in e-commerce. The experimental results showed that the proposed model based on time series analysis is more successful in comparison with other models (random forest, Autoregressive Integrated Moving Average, Convolutional Neural Network, Multilayer Perceptron). It is argued that it is important for companies to consider ethical concerns when applying AI in social media environment as it can result in consumers' distrust [18].

The second-largest cluster (#1) called "Lean global startup" has 22 members. This cluster is focusing on the use of AI to make strategic decisions. [19] argue that the application of AI in strategic marketing decisions has a number of benefits such as identification of missing data, increased rationality, incorporation of learning from experience, and creation of a common basis for decision-making.

Cluster #2 is named as "Revenue model" and has 20 members. The studies in this cluster are focusing on ways to maximise companies' revenues. For example, [20] built and tested a simulation model using large-scale eye-tracking data to train an artificial neural network. It was found that the model helps to forecast gaze hits for various types of marketing communications (e.g. sponsorship, product placement, in-game advertising) .

Cluster #3 is named "Marketing excellence" and has 20 active members. Marketing excellence refers to the activities that shape the organisation, market, and environment [21]. One of the studies from this cluster by [22] focused on the effect of user-generated content from social media platforms on stock performance in the context of b2b and b2c companies. The study collected a dataset of 84 million tweets and 8 years of stock data for 407 companies. By using machine learning methods it was found that UGC has a positive impact on the company's stock performance. It was also found that this impact is stronger for b2c companies in comparison with b2b companies.

All eight clusters, their size, and example of studies are presented in Table 5.

Table 5. Clusters of research hotspots in the field of AI in Marketing.

ID	Name of cluster label	Cluster size	Example of studies
0	Blog mining	23	[16, 17]
1	Lean global startup	22	[19, 23]
2	Revenue model	20	[20, 24]
3	Marketing excellence	20	[21, 22]
4	Business value	18	[25, 26]
5	Islamic countries	17	[27, 28]
6	Autonomous shopping system	10	[29, 30]

7	Information-sharing behaviour	9	[31, 32]
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## 5 Conclusion

The current study identified the knowledge domain in the field of AI in Marketing by using the analysis of temporal distribution, cited countries, cited journals, cited authors, and hotspots from 1992 to 2020. The CiteSpace software was used for this quantitative analysis and visualizing the knowledge gap in AI in Marketing research. As a result, a holistic picture of this domain is provided which can help researchers to get an overview of this developing field.

Use of AI by companies can lead to new business models and create business value, as it has been proposed for big data analytics and ML techniques [18, 33-35]. Additionally, AI could be used beyond marketing in other fields such as healthcare, manufacturing, operations management, and transportation to name a few [36-38].

This study has some limitations. All the retrieved research articles were English-based, which could result in neglecting publications written in other languages. Future studies could conduct a study using multilanguage publications. Additionally, future research could use other databases such as Scopus and Google scholar to conduct the analysis.

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